CLAIMS

WE CLAIM AS OUR INVENTION:

1. A materials joining process comprising:

cold working a surface of a substrate; and

bonding a consumable insert to the substrate surface with a transient liquid phase bonding process;

wherein the substrate surface is cold worked to a degree sufficient to cause grains nucleating in a molten region of the consumable insert during the transient liquid phase bonding process to grow into the substrate to produce bond line grains having a size exceeding a thickness of the molten region.

2. The process of claim 1, further comprising:

cold working respective surfaces of two substrates; and

bonding the two surfaces together with the consumable insert during the transient liquid phase bonding process.

3. The process of claim 2, further comprising cold working each of the two respective surfaces to a different degree.

4. The process of claim 1, further comprising imparting an uneven pattern of cold working stress into the surface.

5. The process of claim 1, further comprising bonding the cold worked surface to an opposed surface that is not cold worked with the transient liquid phase bonding process.

6. The process of claim 1, further comprising shot peening the surface to within the range of 8-16 on the Almen A scale.

7. The process of claim 1, wherein the substrate surface is cold worked to a degree sufficient to cause grains to grow into the substrate to a size at least twice the thickness of the molten region.

8. The process of claim 1, wherein the substrate surface is cold worked to a degree sufficient to cause grains to grow into the substrate to a size at least three times the thickness of the molten region.

9. The process of claim 1, wherein the substrate surface is cold worked to a degree sufficient to cause grains to grow into the substrate to a size at least four times the thickness of the molten region.

10. A materials joining process comprising:

applying a joining process to join two substrates to form a joint having grains;

cold working the substrates proximate the joint; and

heat treating the substrates and the joint together to recrystallize and grow the joint grains;

wherein the substrate is cold worked to a degree sufficient to cause the joint grains to recrystallize and grow into the substrate during the heat treating step.

11. The process of claim 10, wherein the joining process comprises a transient liquid phase bonding process, and wherein the joint grains grow into the substrate to a size greater than a thickness of a molten region existing during the transient liquid phase bonding process.

12. A materials joining process comprising:

cold working a substrate surface;

applying a second material against the cold worked substrate surface;

heating the second material and cold worked substrate surface together to a bonding temperature; and

wherein the substrate surface is cold worked to a degree sufficient to allow grains nucleating in the second material to grow into the substrate surface during the heating step.

13. The process of claim 12, wherein the substrate material comprises a first substrate material and the second material comprises a second substrate having a surface.

14. The process of claim 13, further comprising cold working the second substrate surface prior to the steps of applying and heating to allow the grains nucleating in the second material to grow into the second substrate during the step of heating.

15. The process of claim 12, wherein the second material comprises a consumable insert that becomes molten during the step of heating.

16. The process of claim 15, further comprising applying the consumable insert between the cold worked substrate surface and a surface of a second substrate during the step of heating to form a bond between the cold worked substrate and the second substrate.

17. The process of claim 16, further comprising cold working the second substrate surface prior to the step of heating so that the grains nucleating in the consumable insert material grow into the second substrate during the step of heating.

18. The process of claim 13, further comprising cold working the second substrate surface prior to the steps of applying and heating to lower a recrystallization temperature of the second substrate surface to below the bonding temperature so that during a heat up to the bonding temperature the second substrate surface will nucleate recrystallized grains and the recrystallized grains will grow into the first substrate during the step of heating.

19. A materials joint comprising non-epitaxial grains nucleated from within a joint region and grown from within the joint region into an adjoined region of a substrate.

20. The materials joint of claim 19, further comprising the grains extending to respective varying distances into the substrate.

21. The materials joint of claim 19, further comprising the grains having a size greater than a thickness of a molten region that had existed in the joint region during a process used to form the materials joint.

22. The materials joint of claim 19, further comprising the grains having a size at least twice a thickness of a molten region that had existed in the joint region during a process used to form the materials joint.

23. The materials joint of claim 19, further comprising the grains having a size at least three times a thickness of a molten region that had existed in the joint region during a process used to form the materials joint.

24. The materials joint of claim 19, further comprising the grains having a size at least four times a thickness of a molten region that had existed in the joint region during a process used to form the materials joint.